REMARKS

Claims 1 and 3-16 are now pending in the application. Claims 1 and 3-9 stand rejected. Claim 1 has been amended to recite that the statistical value is a root-mean-square value as claimed in original claims 3, 5, 7, and 9. Claims 3, 5, 7, and 9 have been cancelled. No new matter has been added and a new search is not necessary. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the remarks contained herein.

REJECTION UNDER 35 U.S.C. § 112

Claims 1-9 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. This rejection is respectfully traversed.

The algorithm disclosed by Applicants relates to a pressure fluctuation based on a root-mean-square, which is a well-known mathematical expression within the skill set of one of ordinary skill in the art. See, *Electronics Engineers' Handbook, 3rd Edition*, Donald G. Fink, et al. at 3-20 (1989). In March 2008, the Federal Circuit noted that a sufficient structure may be provided when Applicants provide "all information necessary to perform the function, except for basic mathematical techniques that would be known to any person skilled in the pertinent art." *Aristocrat Tech. Australia PTY Ltd. V. Int'l Game Tech.*, Slip Opinion 2007-1419 at p. 13 (Fed. Cir. March 28, 2008). Applicants' fuel cell includes a controller which controls the fuel cell using logic based on pressure fluctuations calculated using a root-mean-square value. The "basic mathematical

technique" of calculating a root-mean-square is a simple statistical calculation well-known to one of skill in the art.

As further written support, Applicants disclose that: "[t]he controller logic is provided in real-time computer 164 for execution in real-time computer 164. In this regard, controller logic 166 is also denoted as 'software' and/or a 'program' and/or an 'executable program' within real-time computer 164 as data schema holding data and/or formulae information and/or program execution instructions. Controller logic 166 is, in a preferred embodiment, machine code resident in the physical memory storage of computer 164." Paragraph [0038]. Applicants go on to disclose that in various embodiments, the controller logic captures the differential pressure measurement signals and executes a Fast-Fourier-Transform on the data. Paragraphs [0044]-[0046].

Accordingly, Applicants have enabled the executable logic for one of ordinary skill in the art. Reconsideration of the claims and removal of the §112 rejection are respectfully requested.

REJECTION UNDER 35 U.S.C. §§ 102/103

Claims 1-9 stand rejected under 35 U.S.C. § 102(b) as being anticipated by OR, in the alternative, under 35 U.S.C. § 103(a) as being unpatentable over DiPierno Bosco et al. (U.S. Patent No. 6,103,409) This rejection is respectfully traversed.

DiPierno Bosco et al. disclose a flooding detector and a system controller that compares the pressure drop measured on the anode and cathode during fuel cell operation, and the pressure drop as measured in the unflooded "reference stack." Column 4, line 62 through Column 5, line 37 and Figure 3. The DiPierno Bosco et al. approach requires that one measure *a priori* all anode and cathode pressure drops at every combination of flow and electrical load condition expected to be encountered during fuel cell operation. The DiPierno Bosco et al. system controller does not include executable logic for determining a differential pressure fluctuation parameter as a representative statistical value from said set of differential pressure signals and accordingly the varied output actions of the fuel cell as claimed by Applicants.

In contrast, Applicants' claimed invention relates to a fuel cell stack having a controller generating a set of differential pressure signals and determining the differential pressure fluctuation parameter or the root-mean-square of the pressure fluctuation. The differential fluctuation parameter is different from the DiPierno Bosco et al. parameter because Applicants' parameter is based on the statistical value determined from the executable logic. The statistical value from the executable logic allows for circuitry control and output based on the root-mean-square of the set, the variance, or the standard deviation, as non-limiting examples. Paragraph [0045].

Applicants respectfully point out that the Federal Circuit stated that "a general purpose computer programmed to carry out a particular algorithm creates a 'new machine' because a general purpose computer 'in effect becomes a special purpose computer once it is programmed to perform particular functions pursuant to instructions from program software.'" *Aristocrat Tech.,* Slip Opinion 2007-1419 at p. 8, internal cites

omitted. Applicants have provided a "new machine" with the real-time computer 164 and controller logic 166 to "carry out a particular algorithm" based on the root-mean-square and differential fluctuation parameter. *Id.* at p. 8. As the control circuitry acts differently based on the unique differential fluctuation parameter based on the statistical value from the executable logic, Applicants' fuel cell is a different machine and is structurally distinguishable from the prior art.

Applicants' claimed invention incorporating the differential fluctuation measurements is a significant improvement over DiPierno Bosco et al. in that no prior knowledge of unflooded stack pressure drop is required because Applicants' detection method considers only fluctuations about the mean pressure drop reading. Applicants' claimed invention provides sensitivity and speed of measurement which is not disclosed, taught by, or inherent in the DiPierno Bosco et al. system which is limited to measurements based on the reference fuel cell.

Applicants' unexpectedly improved speed and sensitivity is illustrated in that the pressure drop indication based on the differential fluctuations provides a reasonable steady-state condition after an elapsed time of only 100 seconds. See Figures 4 and 6. Additionally, Applicants' invention facilitates sampling at 10 Hz or greater which is much more amenable to automotive fuel cell operation where the dynamic load following operation rarely allows for greater than several minutes at a fixed load condition. Paragraph [0044]. To the contrary, the DiPierno Bosco et al. pressure drop indication attains a reasonable stead-state condition after an elapsed time of 1000 seconds. Figure 4. Applicants' claimed invention provides a 10-fold increase in speed and in sensitivity. Applicants assert that the unexpected results provide secondary

considerations of patentability which Applicants assert weigh in favor of patentability and non-obviousness. See *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966).

Additionally, Applicants' claimed fuel cell provides "an accurate determination of the onset of flooding status and control", "optimization of stoichiometry with a comparable optimization of air compressor capacity, efficient management of rapid power transits, and data for effective management of stack purge." Paragraph [0054].

As DiPierno Bosco et al. do not disclose, teach, or suggest Applicants' claimed invention as amended, reconsideration of the claims and removal of these rejections are respectfully requested.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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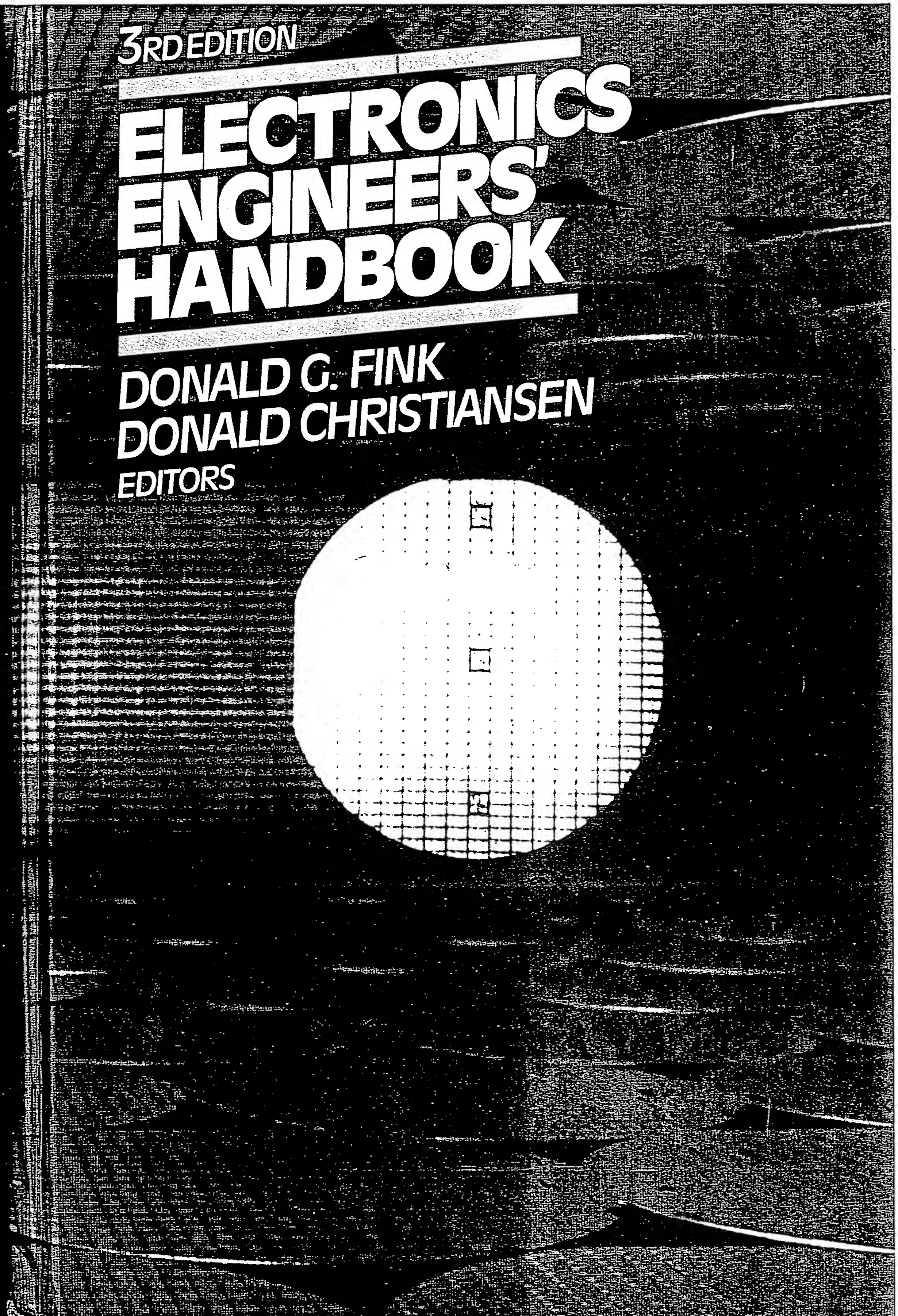
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where $\theta_n = \tan^{-1}(a_n/b_n)$. However, the series for many simple waveforms can be reduced to a series in sine terms only (or cosine terms only) by a judicious choice of the zero of the independent variable (x in the scaled series, t in the actual function). For example, if the zero can be chosen so that the function $f(t)$, as in Fig. 3-24*a* and *b*, is an odd or even function, the series contains only the sine or only the cosine terms, respectively.

23. Parseval's Theorem. One extremely useful shortcut resulting from Fourier analysis is Parseval's theorem, which enables one to calculate the *root-mean-square* (rms) or *effective* value of a periodic function directly from the Fourier series, without determining the time function. If $h(t)$ is a nonsinusoidal periodic function,

$$[h(t)]_{\text{rms}} = \sqrt{\left(\frac{a_0}{2}\right)^2 + \left(\frac{a_1}{2}\right)^2 + \left(\frac{a_2}{2}\right)^2 + \cdots + \left(\frac{a_n}{2}\right)^2 + \left(\frac{b_1}{2}\right)^2 + \left(\frac{b_2}{2}\right)^2 + \cdots + \left(\frac{b_n}{2}\right)^2} \tag{3-22}$$

24. Fourier Transforms. The method used for Fourier-series analysis can be extended to include *nonperiodic* functions, or *transients.* In this case the infinite-series sum becomes a continuous function expressed as an integral, the *Fourier transform.* As mentioned previously, the time-function expression for any time-varying signal $h(t)$ is termed its *time-domain* representation. The mathematical equivalent of the same signal in the *frequency domain* is the sum of the infinite number of infinitesimal sinusoidal signals with the relative amplitude and phase at each frequency f_n given by the *Fourier transform* $F(\omega_n)$ of the signal $h(t)$, or

$$F(\omega_n) = \frac{1}{2\pi}\int_{-\infty}^{\infty} h(t)e^{-j\omega_n t}\,dt \tag{3-23}$$

where ω_n, the angular frequency, is equal to $2\pi f_n$.

In the above form of the Fourier integral, the relative amplitude of each component $F(\omega_n)\,d\omega$ is actually the amplitude of an exponential excitation, $F(\omega_n)e^{j\omega_n t}\,d\omega$, rather than the amplitude of a sinusoidal excitation, and the steady-state components are understood to exist in the spectrum space from $\omega_n = -\infty$ to $\omega_n = +\infty$. With sinusoidal excitation, no significance is attached to a negative frequency. In terms of the above $F(\omega)$, however, the relative component, in the conventional sinusoidal sense, at each angular frequency ω_n comprises the sum $F(+\omega_n)e^{+j\omega_n t} + F(-\omega_n)e^{-j\omega_n t}$. The exponential form of excitation, with frequencies from $\omega_n = -\infty$ to $\omega_n = +\infty$, is quite convenient analytically. It has the further advantage that in the form $e^{(+\sigma+j\omega)t}$ it can represent damped (for σ negative) trains of sine waves. In this representation, the coefficient $+\sigma + j\omega$ is known as the *complex frequency.* The plot of $F(\omega_n)$ as a function of frequency is known as the *frequency spectrum* of the signal $h(t)$.

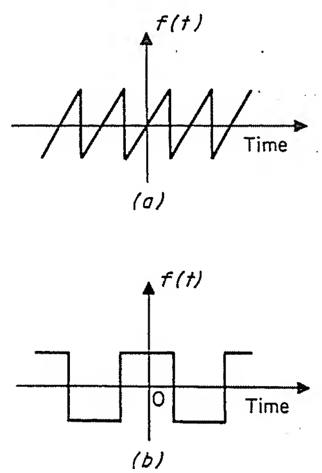

Fig. 3-24. (*a*) A sawtooth wave positioned so that it is an odd function; that is, $f(t) = -f(-t)$; (*b*) a square wave positioned so that it is an even function; that is, $f(t) = f(-t)$.

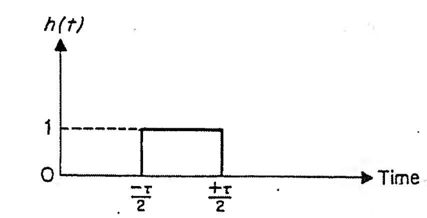

Fig. 3-25. Ideal pulse signal of duration τ_1 and unit amplitude.